§ 3. In the special case of parabolical orbits (1) becomes

$$\theta_1 r_1^2\left(1-\frac{2\mu_1}{r_1^3}\right)-\theta_2 r_2^2\left(1+\frac{2\mu_2}{r_2^3}\right)+\theta_3 r_3^2\left(1-\frac{2\mu_3}{r_3^3}\right)=0 \qquad (2)$$

—a relation between three heliocentric distances and the time.

§ 4. Let E_1, E_2, E_3 be the corresponding excentric anomalies, then we have

$$(r_1-a)\sin(E_3-E_2)-(r_2-a)\sin(E_3-E_1)+(r_3-a)\sin(E_2-E_1)=0,$$

while (1) may be written in the form

$$(r_1-a)\theta_1\left(r_1+a+\frac{2\mu_1}{ar_1}\right)-(r_2-a)\theta_2\left(r_2+a-\frac{2\mu_2}{ar_2}\right)+(r_3-a)\theta_3\left(r_3+a+\frac{2\mu_3}{ar_3}\right)=0.$$

Hence, comparing the two above equations, we see that

$$\sin(E_3-E_2) \qquad \sin(E_3-E_1) \qquad \sin(E_2-E_1)$$

are respectively proportional to

$$\theta_1\left(r_1+a+\frac{2\mu_1}{ar_1}\right) \qquad \theta_2\left(r_2+a-\frac{2\mu_2}{ar_2}\right) \qquad \theta_3\left(r_3+a+\frac{2\mu_3}{ar_3}\right)=0.$$

Observations of the Satellite of Neptune from Photographs taken at the Royal Observatory, Greenwich, between 1902 *January* 6, *and April* 10.

(*Communicated by the Astronomer Royal.*)

The following measures of position-angle and distance of *Neptune's* satellite were made from photographs taken with the 26-inch refractor of the Thompson equatorial. The occulting shutter was generally used, and the position of the plate adjusted so that the planet was behind the shutter while the satellite was just outside of it. By means of the shutter, which is pivoted (see *Monthly Notices*, vol. lx. No. 7), short exposures were given at intervals to the planet. Rapid plates were used, and the exposures given to the satellite were from 10^m to 30^m, generally 20^m. For the planet the short exposures, which may be taken as about $\frac{1}{10}^s$ in duration, were given each half-minute. Thus to an exposure of 20^m on the satellite there would be thirty-nine of these short exposures on the planet.

The zero of position-angle was obtained by stopping the clock and giving a short supplementary exposure. Generally, several short exposures were given, the clock being stopped for a short time between each of them, so that each photograph contains, in

addition to the long-exposure photograph of the satellite, a of number short-exposure images of *Neptune*.

On some of the photographs the duration of the supplementary exposures was adjusted so as to give images of the planet of the same size and density as the image of the satellite. Incidentally these determine the length of exposure given with the occulting shutter, but they are of photometric importance as showing that the satellite requires an exposure 420 times that of *Neptune* to give an equal photographic image, which, on the assumption that the photographic effect is the same for the same total amount of light, makes the satellite $6^{m}\cdot55$ fainter than *Neptune*.

The following table gives the details of these observations :—

No of Plate.	Date.	Exposure of Satellite.	Exposure of Planet giving an Equal Image.	Ratio.	Log.	Diff. of Magnitude.
	1902.	m	s			
1106	Feb. 12	20	2·9	414	2·617	6·54
1115	Feb. 28	21	2·7	467	·669	6·67
1119	Mar. 3	20	3·0	400	·602	6·51
1120	Mar. 3	15	2·5	360	·556	6·39
		20	3·0	400	·602	6·51
1121	Mar. 3	20	2·5	480	·681	6·70
			Mean	420	2·621	6·55

The photographs were measured in a position micrometer in direct and reversed positions by Mr. Dyson, Mr. Davidson, and Mr. Melotte, and the results obtained by each measurer are given in order to show the degree of accordance obtained.

Corrections have not been applied separately to the distances or angles for refraction. These will in all cases be less than $0''\cdot01$. The mean effects of refraction and aberration have, however, been included in the adopted value of the scale, as these corrections affect the mean distance of the satellite slightly, and would directly affect the mass of *Neptune* determined from these observations.

The value of 1^{rev} of the screw of the measuring micrometer was determined in terms of a réseau interval of one of Gautier's réseaux used in photographic work with the Thompson and Astrographic equatorials. For photographs with the Thompson equatorial cleared of the effect of differential refraction and aberration the réseau interval $= 150''\cdot89$. The correction for differential refraction on these photographs of *Neptune* varies from $+''\cdot042$ to $+''\cdot072$, and for differental aberration from $+0''\cdot006$ to $+''\cdot010$. A mean total correction of $+''\cdot07$ has been adopted, giving the réseau interval $= 150''\cdot96$, and has been used for all the photographs.

The tabular positions were computed from the data given in the *Connaissance des Temps*, based on M. H. Struve's elements, the eccentricity of the orbit being neglected owing to the uncertainty as to the present position of the periastron.

1902MNRAS..62..622.

Neptune and Satellite.

Position-angle and Distance, from Photographs taken with the 26-inch Refractor.

Date. 1902.				Position-angle.						Distance.						Exposure.	Remarks.
	d	h	m	s	D.	C.D.	P.M.	Mean.	Tab.	T−O.	D.	C.D.	P.M.	Mean.	Tab.	T−O.	m	
Jan.	6	11	14	13	306°·46	305°·53	304°·35	305°·45	307°·41	+1°·96	12″·77	13″·04	13″·04	12″·95	12″·83	−0″·12	20	Neptune not occulted.
	6	12	14	53	304·86	303·82	306·22	304·97	304·60	−0·37	12·65	12·81	12·83	12·76	13 09	+0·33	20½	
	14	11	36	56	196·58	196 14	195·40	196·04	197·33	+1·29	11·20	11·11	10·98	11·10	11·49	+0·39	25	
	14	12	4	48	194·45	195·06	194·87	194·79	195·65	+0·86	11·21	11·44	11·38	11·34	11·40	+0·06	20	Neptune not occulted.
	24	9	7	14	289·11	288·67	288·27	288·68	290·52	+1·84	14·21	14·29	14·16	14·22	14·48	+0·26	20½	
	24	9	36	34	289·60	288·38	287·65	288·54	289·46	+0·92	14·60	14·76	14·71	14·69	14·61	−0 08	20	Neptune not occulted.
	28	12	7	23	58·82	59·00	59·50	59·11	59 80	+0·69	15 46	15·40	15·07	15·31	15·43	+0·12	21	
	28	12	35	39	57·00	57·80	57·19	57·33	58 86	+1·53	14·51	14·75	14·51	14·59	15·32	−0·27	21	Neptune not occulted. Windy.
	29	10	37	6	351·52	352·70	351·62	351·95	353·30	+1·35	10·63	10·65	10·48	10·59	10·75	+0·16	30	
	29	11	15	6	348·70	349·25	347 01	348·32	350·77	+2·45	10·80	10·63	10·86	10·76	10·75	−0·01	34	Neptune not occulted.
	30	9	16	58	282·75	282·39	282·26	282·47	283·98	+1·51	15·11	15·35	15·27	15·24	15·18	−0·06	25	
	31	8	8	53	244·58	243·96	244·83	244·46	244·48	+0·02	15·98	16·25	16·10	16·11	15·90	−0·21	25	
Feb.	10	8	55	20	336·17	335·37	337·38	336·31	336 90	+0·59	11·21	10·86	10·85	10·97	10·86	−0 11	6	
	10	9	20	48	333·57	332·97	334·33	333·62	335·25	+1·63	10·79	10·98	11·08	10·95	10·91	−0·04	10	

Date. 1902.				Position-angle.						Distance.						Exposure.	Remarks.
	d	h	m	s	D.	C.D.	P.M.	Mean.	Tab.	T−O.	D.	C.D.	P.M.	Mean.	Tab.	T−O.	m	
Feb.	11	7	9	16	277°08	276°23	276°30	276°54	276°77	+0°23	15″86	15″89	15″87	15″87	15″83	−0″04	20	
	11	7	37	24	274·13	274·40	274·32	274·28	275·92	+1·64	15·67	15·83	15·95	15·82	15·91	+0·09	20	
	11	8	11	9	274·22	274·07	274·00	274·10	274·90	+0·80	16·10	15·99	15·84	15·98	16·01	+0·03	20½	
	11	8	39	21	273·75	273·85	273·72	273·77	274·08	+0·31	16·09	16·06	15·95	16 03	16·08	+0·05	20	
	12	7	51	5	233·48	233·12	232·25	232·95	233·50	+0·55	14·57	14·71	14 99	14·76	14·65	−0·11	20	
	13	8	13	25	151·67	151·43	152·95	152·02	153·93	+1·91	10·92	10·53	10·54	10·66	10·94	+0·28	30	Satellite badly defined.
	15	8	2	34	49·11	49·18	48·80	49·03	49·87	+0·84	14·18	13·89	13·88	13·98	14·22	+0·24	30	
	15	9	3	39	47·00	46·06	49·04	47·37	47·55	+0·18	13 73	13·56	13·92	13·74	13·95	+0·21	20	Satellite badly defined.
	16	7	5	31	330·15	329·62	329·92	329·90	332·68	+2·78	11·14	10·59	10·78	10·84	10·96	+0·12	20	Satellite badly defined.
	16	8	19	44	326·27	325 88	326·78	326·31	328·08	+1·77	11·16	11·25	10 91	11·11	11·14	+0·03	20½	
	28	7	59	1	309·30	309·10	308·96	309 12	309·68	+0·56	12·10	12·37	12·33	12·27	12·23	−0·04	21	
	28	8	48	39	308·08	307·13	308·56	307·92	307·25	−0·67	11·97	12·15	12·00	12·04	12·44	+0·40	20	
	28	9	26	28	305·73	304·88	305·43	305·35	305·45	+0·10	12·47	12·58	12·32	12·46	12·60	+0·14	20	
Mar.	1	8	27	0	258·13	257·30	257·88	257·77	259·57	+1·80	16·60	16·33	16·28	16·40	16·55	+0·15	21	
	3	7	19	54	125·72	126·46	126·45	126·21	127·27	+1·06	12·59	12·58	12·60	12·59	12·41	−0·18	20	
	3	8	5	20	124·65	124·08	124·75	124·49	125·12	+0·63	12·59	12·67	12 61	12·62	12·61	−0·01	15	
	3	8	29	1	122·57	123·22	123·03	122·94	124·02	+1·08	12·58	12·63	12·59	12·60	12·71	+0·11	20	
	3	9	6	0	121·20	121·29	121·56	121·35	122·33	+0·98	12·53	12·73	12·59	12·62	12·87	+0·25	20	
	3	9	34	45	121·12	121·04	120·74	120·97	121·05	+0·08	13·12	13·08	12·90	13·03	13·00	−0·03	20	

Date. 1902.				Position-angle.						Distance.						Exposure.	Remarks.
	h	m	s	D.	C.D.	P.M.	Mean.	Tab.	T−O.	D.	C.D.	P.M.	Mean.	Tab.	T−O.		
d				°	°	°	°	°	°	″	″	″	″	″	″	m	
Mar. 17	9	49	44	357·08	356·23	355·62	356·31	358·54	+2·23	10·64	10·72	10·78	10·71	10·54	−0·17	20	Satellite in the glare of Neptune.
19	7	59	16	245·35	245·10	245·33	245·26	245·48	+0·22	15·41	15·52	15·59	15·51	15·66	+0·15	10	
19	8	24	43	244·17	244·42	244·32	244·30	244·72	+0·42	15·28	15·22	15·30	15·27	15·59	+0·32	10	
19	8	52	16	242·92	243·37	243·15	243·15	243·89	+0·74	15·11	15·28	15·67	15·35	15·51	+0·16	10	
21	8	6	21	102·73	102·70	103·68	103·04	104·17	+1·13	14·73	15·01	14·94	14·89	14·72	−0·17	12	
21	8	35	26	102·80	103·17	103·26	103·08	103·20	+0·12	14·62	14·74	14·69	14·68	14·82	+0·14	12	
21	9	16	6	100·07	100·67	100·51	100·42	101·87	+1·45	14·72	14·73	14·46	14·64	14·97	+0·33	12	
22	9	25	4	59·37	59·65	59·61	59·54	60·13	+0·59	14·86	14·95	14·80	14·87	15·10	+0·23	12	
25	6	57	55	239·65	239·69	239·31	239·55	241·99	+2·44	15·04	15·08	15·12	15·08	15·26	+0·18	20½	
25	8	32	38	238·47	238·44	238·80	238·57	238·98	+0·41	14·75	14·85	14·87	14·82	14·95	+0·13	20	
25	9	4	3	237·38	237·93	237·68	237·66	237·95	+0·29	14·97	14·92	15·06	14·98	14·84	−0·14	20	
27	7	58	25	99·98	99·52	99·07	99·52	98·74	−0·78	14·77	15·10	15·05	14·97	15·25	+0·28	12	Satellite very faint.
27	8	19	55	96·18	96·28	95·23	95·90	98·07	+2·17	15·67	15·60	15·52	15·60	15·31	−0·29	12	Satellite very faint.
27	8	46	45	96·22	96·66	96·35	96·41	97·25	+0·84	15·54	15·53	15·77	15·61	15·40	−0·21	20	
27	9	13	9	95·58	95·50	95·77	95·62	96·45	+0·83	15·66	15·55	15·22	15·48	15·47	−0·01	20	
Apr. 6	8	1	49	227·03	227·28	227·40	227·24	227·60	+0·36	13·47	13·31	13·22	13·33	13·57	+0·24	20	
10	8	11	37	319·50	319·25	318·75	319·17	319·76	+0·59	11·07	10·98	11·03	11·03	11·26	+0·23	15	
10	8	37	35	317·01	316·63	316·36	316·67	318·31	+1·64	11·20	11·21	11·10	11·17	11·35	+0·18	15	

Observation of Saturn on 1902 *July* 17, *made at Perth Observatory, Western Australia.*

(*Communicated by W. Ernest Cooke, M.A., Government Astronomer.*)

As astronomers have been asked for observations of *Saturn* about July 17, I beg to report as follows :—

July 17 between 0^h and 1^h G.M.T. Definition remarkably good. Instrument, 10-inch guide telescope of astrograph. Power of eyepiece not measured but estimated about 600. The division could be distinctly traced across the planet, with no sign of a break.

This was the only chance we had, the weather on each side being cloudy or definition bad.

The north polar regions were very dark.

1902 *July* 21.